Memo

To:	CCB
From:	K. Biegalski (with contributions from the entire RMS team)
Date:	July 21, 2000
Subject:	Radionuclide Monitoring System Software Upgrades
Sponsor:	S. Biegalski
CC:	R. Mason

Abstract

This memo is the second to recommend installation of enhancements and additions to the Radionuclide Monitoring System (RMS) software into operations at the PIDC as part of Release 3. This will facilitate the testing of such software in operations before eventual transition to the IDC as part of RMS 3.0. The software changes described herein

- support the interactive and manual analysis of three-dimensional (3-D) beta-gamma coincidence data from noble gas stations,
- include an upgraded Trendvue,
- include two new radionuclide messages – the Radionuclide Laboratory Report (RLR) and the gas background pulse height data (GASBKPHD) message, and
- support multiple revisions of the Standard Screened Radionuclide Event Bulletin (SSREB).

Statement of Objective

The objective of this proposal is the implementation of changes and enhancements to the RMS software into PIDC operations for Release 3 (R3). Upgrades to the following RMS components are included in the software package:

- Trendvue
- Data messages
- Data products
- Subscriptions and requests
- Noble gas nuclide library
- Database design

New elements of the RMS software described in this memo include the following:

- **CO**incident **R**adiation **I**nteractive **AN**alysis **T**ool (CORIANT)
- Automatic analysis algorithm for 3-D beta-gamma coincidence data from noble gas stations (*rms_xanalyze*)
- RLR
- SSREB revision tool
- GASBKPHD message

This proposal completes the description of changes to the RMS software for Release 3, and supplements CCB-PRO-00/05.

To improve the readability of this proposal, a glossary of acronyms is available at the end of the document.

Summary of Proposed Changes

CORIANT

CORIANT is the new review tool for 3-D beta-gamma coincidence data. CORIANT displays the results of *rms_xanalyze* and allows the analyst to add comments to samples.

The main CORIANT window displays six tabbed windows. The first tab is the Histogram window, which shows the sample data currently under review; the other five tab windows are called region of interest (ROI) tabs. Each ROI tab shows detailed information about each of the possible nuclides found in the sample. The five ROI tabs are ^{214}Pb, ^{135}Xe, ^{133}Xe, ^{133m}Xe, and ^{131m} Xe. (See **Figure 1**.)

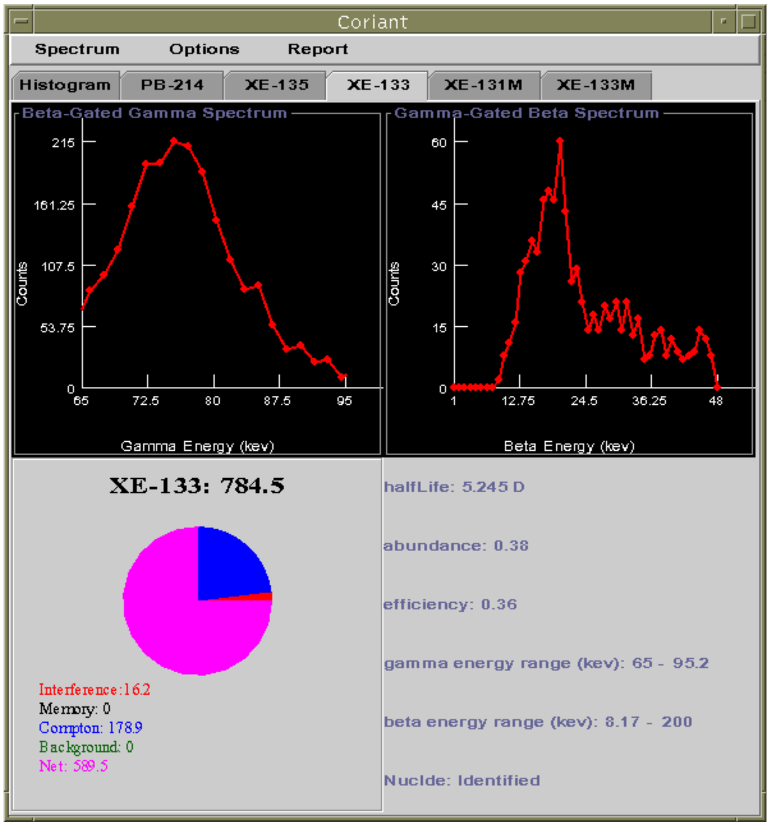


Figure 1. The Main CORIANT Window Displaying the ^{133}Xe Tab

Histogram Window

The Histogram window (**Figure 2**) shows a color-coded two-dimensional (2-D) representation of the beta-gamma coincidence data. Each dot on the display represents the counts detected for one beta/gamma channel pair. The color of the dot indicates the number of counts at that beta/gamma channel. ROI boxes can be overlaid on the histogram to show the exact locations of the five ROIs used for nuclide identification and quantification. The ROI overlay helps the analyst determine if the energy/channel calibration equations are correct. At the bottom of the Histogram window, a text area displays the sample id, decay time, collection start time, collection stop time, acquisition time, quantity, and average flow rate of the sample.

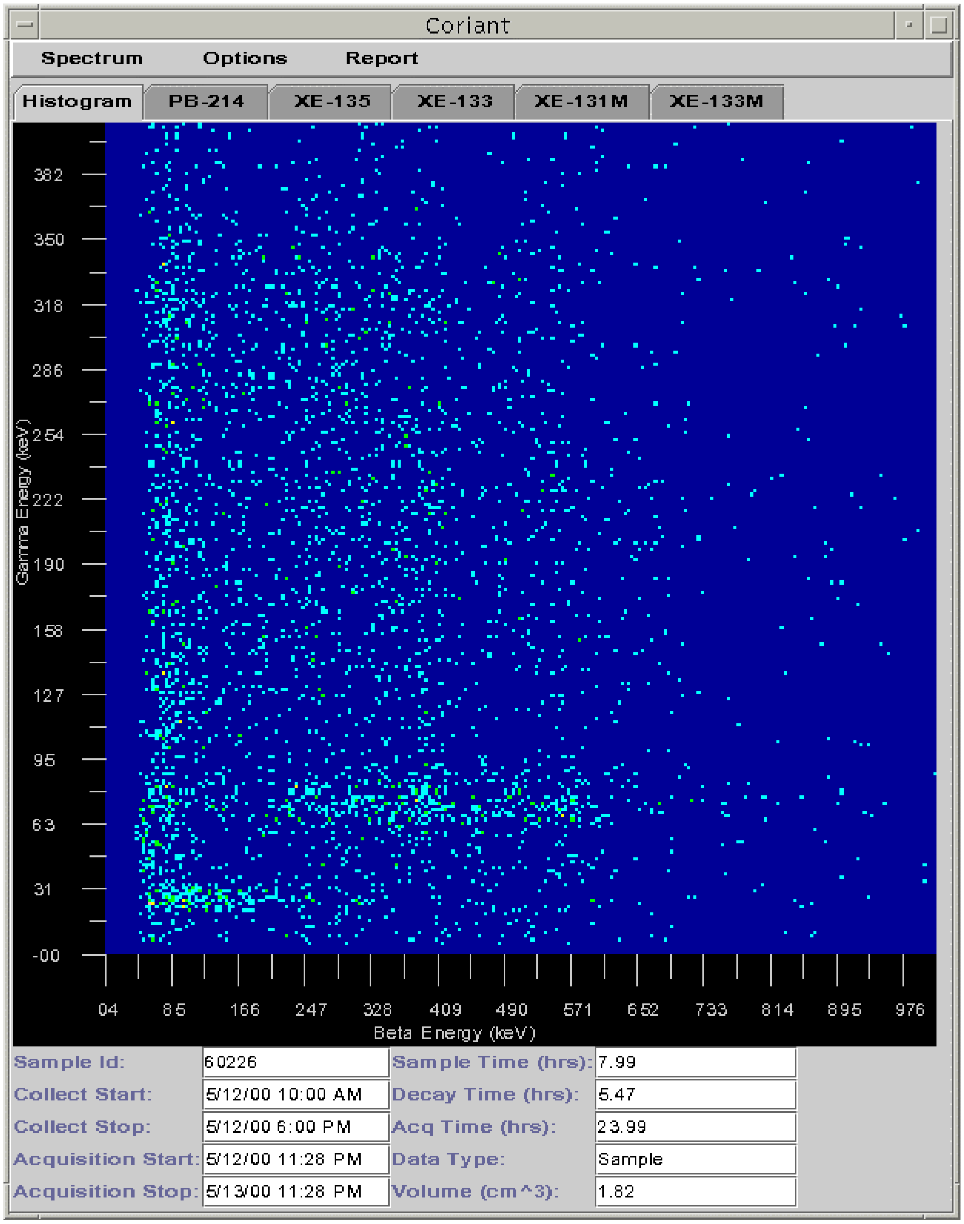


Figure 2. CORIANT Histogram Window

ROI Tab Windows

Each ROI tab window represents one of the nuclides that can be found in the beta-gamma coincidence spectra. There are four sub-windows on each ROI tab window:

- Beta-Gated Gamma graph – shows a plot of the beta-gated gamma spectrum over that ROI
- Gamma-Gated Beta graph – shows a plot of the gamma-gated beta spectrum over that ROI
- Count summary pie chart – graphically represents how the gross counts were dis-

tributed between interference counts, memory counts, Compton counts, background counts, and net counts from *rms_xanalyze*

- Information summary – displays the nuclide half-life, coincidence event abundance, and coincidence event detection efficiency

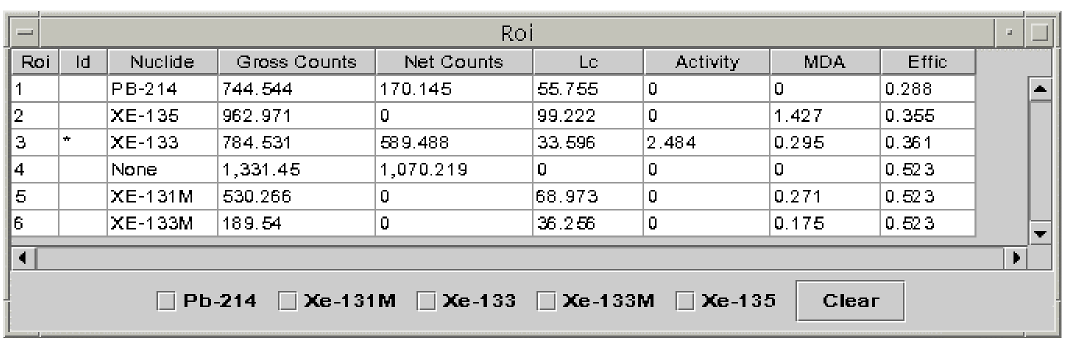
Station/Detector Window

The Station/Detector window displays the name, location, and type of station and detector.

ROI Window Table

The ROI window (**Figure 3**) is a tabular display that has one row for each of six ROIs. Note: ROI #4 is not used for nuclide identification or quantification in the R3 installation, however it will likely be used in the R4 version. The columns in the table include ROI number, nuclide name, gross counts, net counts, critical level (L_c), activity, minimum detectable activity (MDA), and ROI beta-gamma coincidence efficiency. Right-clicking the mouse on a row in the ROI window displays a pop-up menu. This menu allows the user to add a comment for the selected ROI, add a general comment for the sample, or plot the activity or MDA of that nuclide over the last 30 days. Comments added from the pop-up window will be added to the Reviewed Radionuclide Report (RRR) when the sample is released.

Along the bottom row of this window are five check boxes that toggle the display of the ROI boxes on the Histogram window.



Roi

Roi	Id	Nuclide	Gross Counts	Net Counts	Lc	Activity	MDA	Effic
1		PB-214	744.544	170.145	55.755	0	0	0.288
2		XE-135	962.971	0	99.222	0	1.427	0.355
3	*	XE-133	784.531	589.488	33.596	2.484	0.295	0.361
4		None	1,331.45	1,070.219	0	0	0	0.523
5		XE-131M	530.266	0	68.973	0	0.271	0.523
6		XE-133M	189.54	0	36.256	0	0.175	0.523

Pb-214 Xe-131M Xe-133 Xe-133M Xe-135 Clear

Figure 3. CORIANT ROI Window Table

Comment Window

The Comment window displays all comments added to the current sample. These comments are included in the RRR when the sample is released.

Library Window

The Library window is a tabular display that has one row for each of the five radionuclides of interest. The table columns give the name, abundance of coincidence event, and half-life of each nuclide.

Release Window

The Release window allows the analyst to mark a sample "released" or "viewed." If a sample is marked "released," then the sample status is set to R in the database, and an RRR report is created and added to the fileproduct table. If the sample is marked "viewed," then the sample status is set to V in the database.

Analyze

The program *rms_xanalyze* is used to automatically analyze beta-gamma coincidence data from noble gas stations. This program was produced in its entirety as part of the R3 software and did not exist in any form in the Release 2 (R2) software. A detailed description of *rms_xanalyze* can be found in the R3 software documentation, IDC 7.1.10, rev. 1 – Radionuclide Software Design in the chapter titled *Radioxenon Detection Software*.

Rms_xanalyze begins by reading the processing parameters and the 3-D spectral data from the database. The histogram is divided into ROIs defined by the gamma-ray energies and beta energies reported in the pulse height data (PHD) message. The gross counts in each ROI are calculated by summing the counts per channel. The net counts are calculated by correcting the gross counts for the affects of Compton continuum background, detector background, gas cell background (i.e., "memory effect"), and interference from other nuclides. Four of these nuclides (^{131m}Xe, ^{133}Xe, ^{133m}Xe, and ^{135}Xe) are used to characterize the spectrum. The calculated air concentration and minimum detectable concentration (MDC) for each categorization nuclide are determined using the net counts and the processing parameters. The nuclide concentration is only reported for categorization nuclides with net counts greater than the L_c.

Trendvue

State of Health (SOH) and noble gas parameters have been added to the suite of parameters that Trendvue is capable of plotting. The following SOH data can be plotted by Trendvue over a user-specified time period: average flow, standard deviation of flow, outside air temperature, outside air pressure, room temperature, humidity, power supply voltage, crystal temperature, nitrogen fill fraction, detector leakage current, and NIMBIN voltage. The following noble gas data can be plotted by Trendvue over a user-specified time period: air concentrations and MDCs for ^{135}Xe, ^{133}Xe, ^{133m}Xe, and ^{131m}Xe. Multiple plots can be overlaid on the same graph, giving the user the ability to compare data from different stations and detectors. As part of this effort, the overall design of the Trendvue code was improved to simplify future modifications.

Messages

RLR Messages

The Radionuclide Lab Report (RLR) message is new for R3. A new database table, gards_rlr, has been created to accommodate these new messages. A new database sequence, *gards_rlr_seq*, will assign a unique id to each RLR.

The gards_rlr database table contains the header information from the RLR and the name of the file where the rest of the report will reside. The original RLR data messages will be stored in $RMS_HOME/data/processed/rlr and the body of the RLR will be stored in $RMS_HOME/data/rlr. RLR messages will be available through subscriptions and requests. To make this possible, a new entry will be made to the fpdescription table for RLR messages and an entry will be made to the fileproduct table for each RLR that comes in. The format for the RLR message can be found in Appendix A as well as an example RLR message. This information will also be published in IDC3.4.1, rev. 2 – Formats and Protocols for Messages.

`#TamperEnv` *Block*

The `#TamperEnv` block has been added to the SOH message. This block contains the state of various field tamper sensors. The format of this block is described in Table 1.

Table 1. #TamperEnv Block Format

Record	Position	Format	Description
1	1-10	a10	#TamperEnv
2-*n*	1-20	a20	tamper sensor name
	22-27	a6	tamper sensor status (`OPEN` or `CLOSED`)
	29-38	i4,a1,i2,a1,i2	date (*yyyy/mm/dd*)
	40-49	i2,a1,i2,a1,f4.1	time (*hh:mm:ss*)
	51-56	i6	SOH data sampling interval duration (s)

Table 2 lists the tamper sensor names recognized by the IDC parsing software. If an invalid name or extra sensor is listed in the `#TamperEnv` block, the record will be saved at the IDC, but not parsed into the database tables. The *tamper sensor name* field was added to accommodate the multiple sensors at some stations, so the SOH message can specify the status of each sensor. More sensor names will likely be added in R4.

Table 2. Tamper Sensor Names Recognized by IDC Parsing Software

Name	Tamper Sensor Location

door1	main entrance
door2	second door
door3	third door
fence	fence entrance
aslid	air sampler lid
aspanel	air sampler panel
fscab	filter storage cabinet
decaycab	decay cabinet
equipcab	equipment cabinet – primarily for automated stations

Beta-Gamma Coincidence Data

Beta-gamma coincidence PHD can now be handled by the pipeline processing. Changes to the data formats are listed below and can be found in more detail in IDC3.4.1, rev 2.

- Several data blocks have been renamed.
  - `#Energy` has been renamed `#g_Energy`
  - `#Resolution` has been renamed `#g_Resolution`
  - `#Efficiency` has been renamed `#g_Efficiency`
  - `#Spectrum` has been renamed `#g_Spectrum`

- Several data blocks have been added to the formats for reporting 3-D beta-gamma coincidence data, as well as high-resolution gamma spectrometric data from noble gas stations.
  - `#Processing`
  - `#b-Energy`
  - `#b_Resolution`
  - `#ROI_Limits`
  - `#b-gEfficiency`
  - `#Ratios`
  - `#b_Spectrum`
  - `#Histogram`

- The GASBKPHD message has been added. This PHD type is for noble gas monitoring systems that observe a "memory effect" during sample acquisition. The counts due to memory effect must be subtracted from the gross counts for accurate sample activity quantification. This data type is different from a DETBKPHD message because the detection cell is not completely empty.

Reports

ARR and RRR Adapted for Beta-Gamma Coincidence Data

A new layout for the Automated Radionuclide Report (ARR) and Reviewed Radionuclide Report (RRR) has been created for accommodating analysis results from noble gas beta-gamma coincidence data. These reports continue to be available through the subscription system and the web. The revised reports have the following sections: SAMPLE INFORMATION, MINIMNUM DETECTABLE CONCENTRATION, ACTIVITY SUMMARY, ROI RESULTS, ROI BOUNDARIES, and CALIBRATION EQUATIONS. The ROI RESULTS and ROI BOUNDRIES sections replace the PEAK SEARCH RESULTS section in the RRR for high-resolution gamma spectroscopy data.

The creation of the revised ARR is executed from the *rms_pipeline* when a new PHD message containing beta-gamma coincidence data is received from the message subsystem. The report location and related information is entered into the fileproduct table. When a sample is released from CORIANT, a RRR is created and written to the fileproduct table. For beta-gamma coincidence data, the only difference between the two reports is that the RRR contains analyst comments. Users can run the *rms_xe_rrr_report* from the command-line. In this case, the output is written to a file called rrr_<sample_id> in the user's current working directory.

SSREB Editor

The Standard Screened Radionuclide Event Bulletin (SSREB) editor allows analysts to revise an existing SSREB by adding comments. The tool consists of two text windows. The upper text window is a read-only area that shows the version of the SSREB that is being modified. The analyst may add comments in the lower text window. When the Save option is selected, a new version of the SSREB will be created and inserted into the fileproduct table. The tool can handle multiple revision generation of the SSREB.

Subscriptions and Requests

GASBKPHD and RLR data will be available through subscriptions and requests. An entry for each message will be made to the fileproduct table and to the fpdescription table. These reports will also be added to the appropriate subscription and request par files.

Nuclide Library

The R3 noble gas nuclide library for high-resolution gamma-ray spectroscopy detection systems is substantially different from the noble gas R2 library. The R2 library contained only FISSION (G) nuclides whereas the R3 library contains FISSION (G), COSMIC, and NATURAL nuclides. The R3 library was generated in the following manner. All gaseous nuclides listed in the Vladimirskiy paper[1] were included as FISSION (G) nuclides. All COSMIC nuclides in the R3 particulate library were included as COSMIC nuclides. All

NATURAL nuclides in both the R3 particulate library and the ^{222}Rn decay chain were included as NATURAL nuclides. Categorization will be performed only with FISSION (G) nuclides. The methodology used in determining the nuclide properties (half-life, line energy, line abundance, and the associated uncertainties) was the same as that used in determining the particulate library nuclide properties.[1] **Table 3** lists the nuclides included in the R2 and R3 libraries.

Table 3. Nuclide Library for Gamma-ray Spectroscopy Xenon Detection Systems

Nuclide	Type	R2	R3
^{127}Xe	FISSION (G)	X	
^{131m}Xe	FISSION (G)	X	X
^{133m}Xe	FISSION (G)	X	X
^{133}Xe	FISSION (G)	X	X
^{135}Xe	FISSION (G)	X	X
^{210}Pb	NATURAL		X
^{214}Bi	NATURAL		X
^{214}Pb	NATURAL		X
^{19}F	COSMIC		X
^{63}Cu	COSMIC		X
^{71m}Ge	COSMIC		X
^{73m}Ge	COSMIC		X
^{74}Ge	COSMIC		X
^{75m}Ge	COSMIC		X
^{113}Cd	COSMIC		X
^{203m}Pb	COSMIC		X
^{204m}Pb	COSMIC		X
^{205}Hg	COSMIC		X
^{206}Pb	COSMIC		X
^{207m}Pb	COSMIC		X
^{207}Tl	COSMIC		X

Database Changes

Appendix B contains a list of changes made to the R3 Database Schema.

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1. Vladimirskiy, L., Mason, L.R., Zahringer, M., and Bohner, J.D., Optimizing the Fission Product Library for Verification of the Comprehensive Nuclear Test Band Treaty, CMR Technical Report 98/29, June 1998.
1. CCB-PRO-00/05

Software Changes

The following table contains the RMS software modules to be replaced or added in this installation.

Table 4. Release 3 IDC Computer Software Components

CSCI/CSC	Description	Changes from Release 2.1
1 Automatic Processing		
1.8 Radionuclide Detection Processing		
rms_xanalyze	Runs detection analysis for beta gamma coincidence data.	New in Release 3
2 Interactive Processing		
2.5 Radionuclide Analysis		
rms_coriant (coriant)	Interactive analysis tool for beta-gamma coincidence data	New in Release 3
rms_trendvue	Executable to graphically display radionuclide data from database	Revised
4 Data Services		
4.6 World Wide Web		
web_env	A Perl script to set up the environment for web executables.	New in Release 3
4.8 Utilities for Radionuclide		
rms_xe_rrr_report	Executable responsible for generating RRR reports from analysis of noble gas beta-gamma coincidence data	New in Release 3
rms_ssreb_editor	Script to call java SSREB editor frame	New in Release 3

Expected Benefits

CORIANT

CORIANT allows an analyst to review beta-gamma coincidence data. This ability was not possible previously and is a requirement for the R3 software installation.

Analyze

The program *rms_xanalyze* automatically analyzes beta-gamma coincidence data from noble gas systems. Without *rms_xanalyze* these data would have to be analyzed manually (e.g., using Excel). This automatic analysis program reduces the typical initial analysis time from hours to seconds and eliminates the need to hire dedicated personnel just to perform the initial analysis of beta-gamma coincidence data.

Trendvue

Trendvue has been redesigned to be more object oriented so that display plots can be easily created by other applications (e.g., CORIANT). Trendvue has been updated to take advantage of the Java 2 platform; Trendvue now utilizes the Swing user interface components instead of the AWT. All of the deprecated java API references have been removed.

Messages

The capability to handle RLR messages fulfills new requirements set by CTBTO. The new PHD messages and PHD message formats enable the incorporation of beta-gamma coincidence data into the radionuclide data formats and protocols. The new block in the SOH message (i.e., `#TamperEnv`) enables the transfer of additional SOH information to the IDC.

Reports

The new format of the ARR and RRR is better suited to display the analysis results of data from noble gas stations employing beta-gamma coincidence detection. The creation of the SSREB revision tool enables the IDC to update the SSREB as new information on an event becomes available. This ability increases the relevancy of the information contained within the SSREB.

Subscriptions and Requests

Enabling the distribution of RLR and GASBKPHD messages through subscriptions and requests makes the data easily accessible to users.

Nuclide Library

Because the noble gas library contains NATURAL and COSMIC nuclides, the associated peaks in sample spectra will now be automatically identified. This reduces the time an analyst would otherwise have had to spend manually identifying peaks. In addition, because the R3 noble gas library is now much easier to understand and interpret because it was systematically generated and fully documented.

Possible Risks and Dependencies

CORIANT

CORIANT is compiled with Java JDK 1.2.1-03 and Java Advanced Imaging 1.0.2 (JAI). Both of these products must be installed before CORIANT can be run. There are no significant risks with CORIANT because it does not update any of the automated analysis results in the database. This version of CORIANT only allows analysts to add comments and mark samples “released.”

Analyze

Although extensively tested with data from prototype units, *rms_xanalyze* has never been tested with station data because there are currently no noble gas stations transmitting beta-gamma coincidence data to the PIDC. When noble gas stations do begin transmitting beta-gamma coincidence data, problems may occur due to data not structured according to the R3 radionuclide data formats. These problems should be correctable within a reasonable period of time.

Trendvue

Trendvue depends on the installation of java JDK 1.2.1-03.

Messages

There are minimal risks associated with receiving RLR, GASBKPHD and other PHD containing beta-gamma coincidence data. The message system will be configured to receive these messages, but if the configuration is not correct, there could be a delay in receiving the data.

Subscriptions and Requests

There are minimal risks associated with sending out RLR and GASBKPHD messages through subscriptions and requests. The message system will be configured to send out these messages, but if the configuration is not correct, there could be a delay in sending out the data.

Reports

There are no risks or dependencies anticipated for the revised ARR and RRR.

Nuclide Library

The risks associated with the R3 noble gas high-resolution gamma spectrometric nuclide library are minimal. The addition of COSMIC and NATURAL nuclides should have no affect on peak identification or spectrum categorization. The removal of ^{127}Xe from the FISSION (G) list should also have no affect because this radioxenon is not expected to be measured by the systems.

Summary of Testing

CORIANT

The CORIANT software is currently installed on the PIDC development system. Analysts and development staff have used this tool to review beta-gamma coincidence data. The analyst has the ability to display a complete sample histogram, as well as individual gamma and beta plots associated with the following radionuclides: ^{214}Pb, ^{135}Xe, ^{133}Xe, ^{131m}Xe, and ^{133m}Xe.

There are no noble gas stations in the prototype radionuclide monitoring system that produce beta-gamma coincidence data. As a result, data generated from the Automated Radioxenon Sampler/Analyzer (ARSA) currently being tested in the Noble Gas Equipment Test in Freiburg, Germany was used for testing the software. While not a small data set, it should be recognized that the data was generated from a prototype system.

Because noble gas systems utilizing beta-gamma coincidence detection are not yet part of the prototype radionuclide monitoring system, there is not yet available a prescribed analyst review process for these data. As a result, software testing for CORIANT was based on analyst procedures for particulate data. Some differences between the review of beta-gamma coincidence and high-resolution gamma-ray spectroscopy data from noble gas systems are worth noting:

1) Only five nuclides are of interest to the analyst; therefore, CORIANT display windows are structured accordingly.
2) In determining the net signal area in a given ROI, the gas background, radionuclide interference(s), Compton continuum, and detector background are all subtracted from the gross signal. As a result, the calculated net signal in a given ROI may be less than zero (but statistically equal to zero). The gas background, radionuclide interference, Compton continuum, and detector background, in addition to the final net areas are displayed in the Count Summary report.
3) The analysis results are provided to the analyst in different formats. These formats include spectral plots, tabular reports, bar graphs, and pie charts.

All options of the CORIANT interactive review tool were tested and found to be in working order.

Analyze

As stated above, there are no noble gas stations in the prototype radionuclide monitoring system that transmit beta-gamma coincidence data. For the testing of *rms_xanalyze*, a data set consisting of 548 ARSA PHD files were utilized as well as some synthetic data. The ARSA data set contains all data, regardless of quality, collected by the ARSA system in Freiburg, Germany between 19 March 2000 and 27 June 2000. The data set is equally divided between GASBKPHD and SAMPLEPHD files. No quality control, detector background, or calibration PHD files were available in the ARSA data set and consequently were not available for testing.

The synthetic data set was used to demonstrate the ability of *rms_analyze* to correctly quantify radioxenon concentrations. No PHD messages of samples with known radioxenon concentrations were available to benchmark the program. Hence, a synthetic SAMPLEPHD file was generated by placing a known concentration (converted to counts) of the principal radionuclides in each of the appropriate ROIs. The sample was given a constant background level. A synthetic GASBKPHD file was generated in a similar manner except that fewer counts were placed in each ROI.

The PHD files were mailed into the **rmsuser** account where they were automatically parsed, stored, analyzed, and characterized. The results of these processes are stored in the **janeauto**/**janeman** databases. The status of the RMS pipeline was verified and the processing of the GASBKPHD and SAMPLEPHD files was shown to be successful. We should note that a small percentage of samples in this data set failed the analysis due to corrupt PHD files. These failures are a result of the ARSA data set containing either an improper sample Xe volume or an improper sampling time and do not reflect poorly on the analysis code.

The status of the RMS automated detection and characterization process was verified by a set of three tests. The first test verified that the average processing time was less than 60 seconds. The second test verified that the proper number of nuclides was identified in the PHD data. The third test verified that the sample characterization functioned properly. In a beta-gamma coincidence system, only category levels 1, 3, 4, and 5 are allowed. All the tests of the RMS automated detection and characterization process proved to be successful.

The analysis of the synthetic PHD files generated results commensurate with what was expected. This adds confidence to the quantification capabilities of the code.

Trendvue

The newest version of Trendvue was tested and the results were favorable. The application has changed in both appearance and functionality for R3. The main Trendvue window appears first, instead of a login box as before. The Open Database Connection, Close Database Connection, Display Lines and Display Cross-hairs options are now accessible through the Administrative pull-down menu. The Add Dataset, View Dataset, Update-Categorization Filters, Remove Active Dataset, View Active Dataset, Print Active Dataset and Remove All Datasets options are now accessible through the Data pull-down menu. The Xe Concentration and State of Health options, which are new to the application, are accessible through the Add Dataset and View Dataset menus.

Messages

RLR Messages

No RLR messages have yet been produced from certified radionuclide laboratories. As a result, synthetic RLR messages were generated to test the system. These messages were sent to the radionuclide system on the PIDC DEV LAN and were successfully parsed and stored. No problems were found with the processing of RLR messages.

#TamperEnv Block

Currently, no radionuclide field stations transmit tamper sensor information to the PIDC. Synthetic SOH messages were generated with `#TamperEnv` block data to test the system. The synthetic SOH data messages were sent to the radionuclide system on the PIDC DEV LAN and were successfully parsed and stored. No problems were found with the processing of SOH messages with `#TamperEnv` blocks.

Beta-Gamma Coincidence Data

PHD messages containing beta-gamma coincidence data were tested in conjunction with the testing of rms_xanalyze. No problems were observed with the processing of messages containing beta-gamma coincidence data.

Reports

ARR and RRR Adapted for Beta-Gamma Coincidence Data

ARRs are created automatically at the end of the sample analysis routine. After the beta-gamma coincidence data set mentioned previously was imported, the production of the revised ARRs was verified. The ARR files were examined and the content verified. No problems were found with ARR production.

RRRs are created after analyst review. Upon completion of the interactive review process, the analyst releases the sample and the RRR is created. For the beta-gamma coincidence noble gas data, the creation of the RRR is generated from CORIANT. To test the production of the revised RRR, multiple samples were released using the CORIANT tool. The RRR files were examined and the content verified. No problems were found with the revised RRR production.

SSREB Editor

When a level 4 or 5 spectrum is released, a SSREB is automatically generated in addition to the RRR. The SSREB may require subsequent editing for the incorporation of additional comments from scientists, laboratory results, and supplementary information relating to measurements of the same event in other locations.

The SSREB editor was tested on the DEV LAN. A few level 4 and 5 samples were released generating the SSREB messages. The SSREB editor was then opened up to add additional information to the SSREB. The changes were saved and a new version of the SSREB message was generated. The entry of the revised SSREB into the fileproducts table was verified. Some SSREB messages were opened multiple times for revision. In each case, the edits were successfully saved and new versions of the SSREB were generated. The testing of the SSREB editor verifies that SSREBs can be successfully edited and that the software supports multiple versions of the SSREB product.

Subscriptions and Requests

In R3, GASBKPHD and RLR data are to be available through subscription and requests. Upon creation of these products, entries are made into the fileproduct table. Testing of subscriptions and requests for GASBKPHD and RLR products consisted of verifying the entry of these products in the fileproduct table. No direct testing through AutoDRM was conducted because it is not available on the PIDC testbed. Negligible risk is induced by the lack of direct AutoDRM testing.

Nuclide Library

The nuclide library to be utilized by the Canberra processing for the analysis of noble gas data from high-resolution spectroscopy systems was tested. Similar to the problem mentioned above for beta-gamma coincidence data, there are currently no noble gas stations that currently transmit high-resolution gamma spectroscopy data to the PIDC. As a result, data from the French SPALAX system (operating as part of the Noble Gas Equipment Test in Freiburg, Germany) was used for testing the new nuclide library.

The data currently produced by the SPALAX system is not in the R3 radionuclide data message format. The data was edited so that it could be imported into the radionuclide pipeline. The SPALAX data files were missing the following sections that had to be manually inserted: `#Processing`, `#g_Energy`, `#g_Resolution`, and `#g_Efficiency`. The data contained in these fields do not affect the testing of the new nuclide library. Once in the correct form, the data was imported to the rmsuser account on the PIDC DEV LAN and analyzed. The analysis worked without problems and the radionuclides in the data were properly identified. These results verify that the revised noble gas nuclide library operates as designed.

Database Changes

A number of database changes are part of the R3 installation. These changes include the addition of new tables used in the analysis of beta-gamma coincidence data, as well as the deletion of obsolete fields within existing tables. Although a number of problems initially arose from the database changes, all RMS applications have been tested and shown to work correctly.

Schedule and Plan for Implementation

Installation of this software is scheduled for July 31 after export of the radionuclide database for back-up. The RMS software installation will be performed as follows.

1. Perform database exports of rmsman and rmsauto users.
2. Shutdown operations pipeline.
3. Alter the database as needed.
4. Load all new executables into a new bin area that will replace the old bin area by updating the proper link.
5. Configure appropriate par files.
6. Create new type IDs for GASBKPHD and RLR as follows:

   `NEWID =` *a new typeid*

   where *a new typeid is the new typeid numbers assigned to GASBKPHD and RLR.*
7. Add GASBKPHD and RLR to the fpdescription table as follows:

   ```
   insert into fpdescription values (NEWID, 'GASBKPHD','Gas Background
     PHD','ASCII','IMS2.0',-1,sysdate);
   insert into fpdescription values (NEWID,'RLR','Radionuclide Lab
     Report','ASCII','IMS2.0',-1,sysdate);
   ```
8. Add GASBKPHD and RLR to the appropriate par files so that both can be received and sent to the radionuclide pipeline as well as sent by subscriptions and requests.
9. Test availability of data and executables.
10. Perform a complete export and re-import of the rmsman and rmsauto accounts to regain space from columns that were set unused.
11. Turn operations pipeline back on.

Costs and Resources for Implementation

The installation will take about 8 hours for 2 people. The installation of this software is dependent upon support from CMR infrastructure personnel for the database import and exports. However, the time required to complete these tasks should be minimal.

Appendix A. RLR Message Format and Example

RLRs contain sample analysis results from a certified radionuclide laboratory. The RLR is comprised of six block types. The required number of blocks in an RLR is described in Table 3.

Table 3. Number of Data Blocks Required in a Radionuclide Laboratory Report

Block Name	Number of Blocks Required in RLR
#Header	1
#Objective	1
#Test	≥1
#Results	≥1
#ResultsDescription	≥1
#Conclusion	1

Formats for the data blocks listed in Table 3 are described in the Tables 4 - 9 below. If a required data block is shown as having an undetermined number of possible records (denoted by, for example, 4-*n*), the minimum number of records is one, unless specified otherwise.

Table 4: #Header Block Format

Record	Position	Format	Description
1	1-7	a7	`#Header`
2	1-5	a5	station code of the station at which the sample was collected
	7-15	a9	laboratory detector code
	17-32	a16	sample reference identification
3	1-10	i4,a1,i2,a1,i2	collection start date (*yyyy/mm/dd*)
	12-21	i2,a1,i2,a1,f4.1	collection start time (*hh:mm:ss*)
	23-32	i4,a1,i2,a1,i2	collection stop date (*yyyy/mm/dd*)
	34-43	i2,a1,i2,a1,f4.1	collection stop time (*hh:mm:ss*)
4	1-10	i4,a1,i2,a1,i2	sample arrival date at lab(*yyyy/mm/dd*)
	12-16	i4,a1,i2	sample arrival time at lab(*hh:mm*)
5	1-10	i4,a1,i2,a1,i2	test completion date at lab(*yyyy/mm/dd*)
	12-16	i4,a1,i2	test completion time at lab(*hh:mm*)
6	1-10	i4,a1,i2,a1,i2	transmit date (*yyyy/mm/dd*)
	12-16	i4,a1,i2	transmit time(*hh:mm*)

Table 5: #Objective Block Format

Record	Position	Format	Description

1	1-10	a10	`#Objective`
2-*m*	1-80	a80	general free text comment describing purpose of testing - what is being investigated and why
m+1	1	a1	blank line to separate free text
m+2 - *n*	1-80	a80	general free text comment describing sample condition or special laboratory handling and storage procedures

Table 6: #Test Block Format

Record	Position	Format	Description
1	1-5	a5	`#Test`
2	1-30	a30	test description or name
3-*m*	1-80	a80	test purpose
m+1	1	a1	blank line to separate free text
m+2 - *n*	1-80	a80	test procedures (including sample preparation, calibration, recording of data, mitigation of environmental factors)

Table 7: #Results Block Format

Record	Position	Format	Description
1	1-8	a8	`#Results`
2	1-30	a30	test description or name
3	1-15	a15	units for concentration data
4-*n*	1-10	a10	nuclide name
	12-24	f13	nuclide concentration
	26-38	f13	concentration uncertainty
	40-52	f13	minimum detectable concentration (MDC)
	54-66	f13	activity ratio

Table 8: #ResultsDescription Block Format

Record	Position	Format	Description
1	1-19	a8	`#ResultsDescription`
2	1-30	a30	test description or name
3-*m*	1-80	a80	description of uncertainty and MDC calculations, description of activity ratios reported
m+1	1	a1	blank line to separate free text
m+2 - *n*	1-80	a80	interpretation of results (including rejection or approval of results and any anomalous findings)

Table 9: #Conclusions Block Format

Record	Position	Format	Description
1	1-12	a12	`#Conclusions`
2-*k*	1-80	a80	summary of IDC findings
k+1	1	a1	blank line to separate free text
k+2 - *m*	1-80	a80	summary of lab findings and conclusions
m+1	1	a1	blank line to separate free text
m+2 - *n*	1-80	a80	discussion of discrepancies between IDC and laboratory results

EXAMPLE RLR

```
DATA_TYPE RLR
#Header
KWP40 FIL07-001 63199709150611
1997/09/29 06:00:00.0 1997/09/30 06:00:00.0
1997/10/29 08:30
1997/11/09 12:00
1997/11/09 16:00
#Objective
```

The PIDC network detected airborne ^{137}Cs in Kuwait on 21-23 September 1996 at concentrations that were beyond normal variability. No ^{134}Cs was found. The laboratory studies should give further data to deduce whether the finding is resuspension of Chernobyl fallout or some other debris.

Before shipment, the filters were cut into four pieces. The samples were sent to different laboratories for a more detailed analysis; the Finnish Centre for Radiation and Nuclear Safety (STUK) received two samples. As indicated above, this is the first of these two sections.

```
#Test
```

Gamma Spectrometry
Gamma spectrometry was performed to determine the activities and minimum detectable concentrations (MDCs) of the ^{137}Cs and ^{134}Cs isotopes. With these values, the ratios of the isotopes can be compared to ratios expected from the Chernobyl fallout.

The samples from Kuwait were prepared for gamma spectrometry by compressing them with a hydraulic press to a cylindrical form of 42 mm in diameter and 4-5 mm in height. The samples were counted with HPGe detectors of 99.8 % and 40.0 % relative efficiencies. The blank filter was treated similarly enabling background peak subtraction. To reduce MDC of ^{134}Cs for obtaining a low minimum detectable activity ratio of $^{134}Cs/^{137}Cs$, the two compressed samples were wrapped in thin plastics and placed one on top of the other without a beaker for a counting period of 3.7 d (99.8 % HPGe).

#Results
Gamma Spectrometry
uBq/m^3

Be-7	5800	3	0.0	0.0
K-40	930	8	0.0	0.0
Cs-134	0	0	2.2	0.015
Cs-137	62	5	0.0	0.0

#ResultsDescription
Gamma Spectrometry
The above results show the MDC of different nuclides in Kuwait in September 1996. The confidence level for the MDCs is approximately 95 % (estimated from 3 times background standard deviation) and the uncertainties are stated as a percent (1 σ). The ratio shown is that of the MDC of ^{134}Cs to the activity of ^{137}Cs. Sample self-absorption and true coincidence correction were taken into account in the analyses of the spectra.

^{134}Cs was not observed when counting on the 100 % detector; however, the MDC allowed for an estimate of the $^{134}Cs/^{137}Cs$ ratio. This ratio corresponds to fuel burn-up of 6,000 MWd/tUO_2. The average burn-up of Chernobyl fuel was 10,000 MWd/tUO_2. Thus, these samples may contain ^{137}Cs that is not explained by the Chernobyl fallout. Further conclusions may be drawn through purification of Cs utilizing methods of radiochemistry.

#Test
Cesium Chemistry
Detection limit of ^{134}Cs can be improved by radiochemistry. Separation of Cs from the compressed filter matrix improves counting geometry and reduces the amount of disturbing natural nuclides. The original plan was to separate $^{137+134}Cs$ with Cs carrier from the sample matrix with AMP precipitation, and, if necessary, to con-

sider an additional separation of Cs from K using Bi iodide and hexachloroplatinate precipitations. Separation of radiocesium with AMP was tested.

Cs carrier (20 mg) was added to the Kuwait sample KW0349B. The filter was wet ashed with nitric and hydrochloric acids. A small undissolved residue was separated from the solution. Cs was coprecipitated by adding 1 g of ammoniummolybdophosphate (AMP) to the solution. The AMP precipitation was separated and measured by gamma spectrometer. The remaining solution was completely evaporated and the dry residue was also measured.

#Results
Cesium Chemistry
uBq

Be-7	17.7	3	0.0	0
K-40	7.5	7	0.0	0
Cs-134	0.0	0	0.014	0
Cs-137	0.24	5	0.0	0
Be-7	0.0	0	0.0	0
K-40	0.0	0	0.0	0
Cs-134	0.0	0	0.0	0
Cs-137	0.03	13	0.0	0
Be-7	5.7	4	0.0	0
K-40	3.5	7	0.0	0
Cs-134	0.0	0	0.0	0
Cs-137	0.21	7	0.0	0

#ResultsDescription
Cesium Chemistry
The above results show the activity concentration (or MDC) of different nuclides in Kuwait in September 1996. The first set are the values for the original compressed filter, the second set for the AMP, and the third for the filtrate residue. The AMP was measured in a geometry with diameter 21 mm while the filtrate was measured as dried evaporation residue in a geometry with diameter 73 mm, height 22 mm and volume 92 cm^3. The confidence level for the MDCs is approximately 95 % and the uncertainties are expressed as a percent (1 σ).

Decomposing the filter with an oxidizing mineral acid HNO_3 resulted in a clear liquid. However, it contained some organic compound which complicated further separations of Cs. Only a small fraction of Cs (13 %) was coprecipitated with AMP (Table 4). The evaporation residue of the filtrate contained most of the cesium. Thus, the detection limit of ^{134}Cs was not improved as compared with the original result.

#Conclusions
^{137}Cs was detected at the IDC with an activity estimated at 65 μBq/

m^3. The ratio of the ^{134}Cs MDC to this activity was approximately 0.15. No Cs-134 was observed in the IDC analysis.

^{137}Cs was detected in the gamma spectrometry and cesium separations performed at the Finnish Centre for Radiation and Nuclear Safety. The ^{137}Cs activity was estimated to be 62 $\mu Bq/m^3$. The ratio of the ^{134}Cs MDC to the ^{137}Cs activity was 0.015. With the extra sensitivity of the gamma spectrometry, it was determined that the ^{137}Cs existed in a proportion greater than that expected from Chernobyl fallout.

Gamma spectrometry in laboratory, using counting times of several days, improved detection limits considerably as compared to routine procedures in the CTBT network. Particular emphasis was placed on analysis method and on nuclide library used by the software. Coincidence correction and self-absorption correction were performed to get reliable activity ratios. Essential reduction of the detection limits in the gamma spectrometry was possible by purifying the sample. Separation of Cs from the filter matrix was applied in the present study to the sample from Kuwait. The filter material contained some unknown compound that interfered with the purification processes. The separation method has worked well for glass fibre filters used by STUK (yield 90 %). The filter matrix should not contain organic or inorganic compounds that make the laboratory analyses more complicated and the chemical procedure itself must be well tested in advance for the filter material used by the sampling station. The use of autoradiography was not easy or fruitful in the analyses of the samples. The Kuwait filters were compressed, i.e., they consist of bulk material that is difficult to handle. Glass fibre filters routinely used in the air sampling programme of STUK do not induce extra blackening. The filter material must be carefully chosen not only for particle collection but also for later laboratory analyses.

STOP

Appendix B – Changes to Database Schema

I. Changes made in support of Noble Gas Processing:

New tables:

GARDS_BG_EFFICIENCY_PAIRS

The **gards_bg_efficiency_**pairs table contains the detection efficiency associated with a beta-gamma coincidence event as specified in the PHD file.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *bg_efficiency*	number	detection efficiency of photon-electron coincidence event
3. *bg_effic_error*	number	uncertainty in *bg_efficiency*
4. *roi*	number	ROI identifier

Keys: Primary: *sample_id/roi*
Foreign: *sample_id* (**gards_sample_data**)
roi (**gards_roi_lib**)

GARDS_B_ENERGY_PAIRS

The **gards_b_energy_pairs** table contains the energy calibration pairs information associated with the beta axis of the spectrum as specified in the PHD file. The values in the **gards_b_energy_pairs** and **gards_b_energy_pairs_orig** tables are identical for R3, but may change in R4.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *decay_mode*	char(1)	type of decay
3. *cal_energy*	number	calibration energy (keV)
4. *cal_error*	number	uncertainty in *channel*
5. *channel*	number	peak centroid channel

Keys: Primary: *sample_id/cal_energy*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_B_ENERGY_PAIRS_ORIG

The **gards_b_energy_pairs_orig** table contains the original energy calibration pairs information associated with the beta axis of the spectrum as specified in the PHD file. The values in the **gards_b_energy_pairs** and **gards_b_energy_pairs_orig** tables are identical for R3, but may change in R4.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *decay_mode*	char(1)	type of decay
3. *cal_energy*	number	calibration energy (keV)
4. *cal_error*	number	uncertainty in *channel*
5. *channel*	number	peak centroid channel

Keys: Primary: *sample_id/cal_energy*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_B_RESOLUTION_PAIRS

The **gards_b_resolution_pairs** table contains the resolution pairs information associated with the beta axis of the spectrum as specified in the PHD file. This table is not used by the R3 rms_xanalyze process. The values in the **gards_b_resolution_pairs** and **gards_b_resolution_pairs_orig** tables are identical for R3, but may change in R4.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *resolution*	number	detector resolution

3. *res_energy*	number	resolution energy (keV)
4. *res_error*	number	uncertainty in *resolution*

Keys: Primary: *sample_id/res_energy*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_B_RESOLUTION_PAIRS_ORIG

The **gards_b_resolution_pairs_orig** table contains the original calibration pairs information associated with the beta axis of the spectrum as specified in the PHD file. This table is not used by the R3 rms_xanalyze process. The values in the **gards_b_resolution_pairs** and **gards_b_resolution_pairs_orig** tables are identical for R3, but may change in R4.

Column	**Storage Type**	**Description**
1. *sample_id*	number	sample identifier
2. *resolution*	number	detector resolution
3. *res_energy*	number	resolution energy (keV)
4. *res_error*	number	uncertainty in *resolution*

Keys: Primary: *sample_id/res_energy*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_HISTOGRAM

The **gards_histogram** table contains information regarding the 3-D beta-gamma coincidence sample data.

Column	**Storage Type**	**Description**
1. *sample_id*	number	sample identifier
2. *filename*	varchar2(256)	name of file containing histogram data
3. *g_channels*	number	number of gamma channels in histogram
4. *b_channels*	number	number of beta channels in histogram
5. *g_energy_span*	number	gamma energy span of detector calibration
6. *b_energy_span*	number	beta energy span of detector calibration

Keys: Primary: *sample_id*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_ROI_CHANNELS

The **gards_roi_channels** table contains the ROI boundaries in channel units that are calculated in *rms_xanalyze*.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *roi*	number	unique ROI identification number
3. *b_chan_start*	number	beta boundary start channel
4. *b_chan_stop*	number	beta boundary stop channel
5. *g_chan_start*	number	gamma boundary start channel
6. *g_chan_stop*	number	gamma boundary stop channel

Keys: Primary: *sample_id/roi*
Foreign: *sample_id* (**gards_sample_data**)
roi (**gards_roi_lib**)

GARDS_ROI_CONCS

The **gards_roi_concs** table contains information regarding the concentration of each identified nuclide that is calculated in *rms_xanalyze*.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *roi*	number	ROI identifier
3. *activity*	number	activity per unit volume air ($\mu Bq/m^3$)
4. *activ_err*	number	uncertainty of *activity*
5. *mda*	number	minimum detectable activity ($\mu Bq/m^3$)
6. *nid_flag*	number	nuclide identification indicator
7. *report_mda*	number	indicator of whether MDA is to be reported

Keys: Primary: *sample_id/roi*
Foreign: *sample_id* (**gards_sample_data**)
roi (**gards_roi_lib**)

GARDS_ROI_COUNTS

The **gards_roi_counts** table contains information regarding the counts that are calculated in *rms_xanalyze* for each ROI.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *roi*	number	ROI identifier
3. *gross*	number	counts in ROI before processing
4. *gross_err*	number	uncertainty of *gross*
5. *compton*	number	compton continuum background counts
6. *compton_err*	number	uncertainty of *compton*
7. *interference*	number	counts from interference nuclides
8. *interference_err*	number	uncertainty of *interference*
9. *memory*	number	gas background (i.e., “memory effect” counts
10. *memory_err*	number	uncertainty of *memory*
11. *detector_back*	number	detector background counts
12. *detector_back_err*	number	uncertainty of *detector_back*
13. *net*	number	counts in ROI after processing
14. *net_err*	number	uncertainty of *net*
15. *lc*	number	critical level counts

Keys: Primary: *sample_id/roi*
Foreign: *sample_id* (**gards_sample_data**)
roi (**gards_roi_lib**)

GARDS_ROI_LIB

The **gards_roi_lib** table relates each ROI to a specific nuclide. The table also contains nuclide properties used in nuclide quantification.

Column	Storage Type	Description
1. *roi*	number	ROI identifier
2. *name*	varchar2(8)	nuclide associated with ROI
3. *halflife*	varchar2(23)	half-life of the nuclide
4. *halflife_err*	varchar2(23)	uncertainty of *halflife*
5. *halflife_sec*	number	numerical half-life in seconds
6. *abundance*	number	intensity of beta/gamma coincidence event
7. *abundance_err*	number	uncertainty of *abundance*

Keys: Primary: *roi*

GARDS_ROI_LIMITS

The **gards_roi_limits** table contains the ROI boundaries in energy units as specified in the PHD file.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *roi*	number	unique ROI identification number
3. *b_energy_start*	number	beta boundary start energy
4. *b_energy_stop*	number	beta boundary stop energy
5. *g_energy_start*	number	gamma boundary start energy
6. *g_energy_stop*	number	gamma boundary stop energy

Keys: Primary: *sample_id/roi*
Foreign: *sample_id* (**gards_sample_data**)
roi (**gards_roi_lib**)

GARDS_SAMPLE_RATIOS

The **gards_sample_ratios** table contains the amount of overlap between each ROI as specified in the PHD file.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *ratio_id*	varchar2(15)	ratio identifier
3. *upper_roi_number*	number	ROI number associated with ROI-1
4. *lower_roi_number*	number	ROI number associated with ROI-2
5. *count_ratio*	number	ratio of ROI-2 counts divided by ROI-1 counts
6. *count_ratio_err*	number	uncertainty in *count_ratio*

Keys: Primary: *sample_id/ratio_id*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_SAMPLE_XE_PROC_PARAMS

The **gards_sample_xe_proc_params** table contains information used for nuclide identification.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *roi*	number	ROI identifier
3. *constant*	number	confidence factor

Keys: Primary: *sample_id/roi*
Foreign: *sample_id* (**gards_sample_data**)
roi (**gards_roi_lib**)

GARDS_SPECTRUM

The **gards_spectrum** table contains spectral data information reported in the PHD file.

Column	Storage Type	Description
1. *sample_id*	number	sample identifier
2. *sample_type*	char(1)	sample type
3. *filename*	varchar2(256)	name of file containing spectrum data
4. *channels*	number	number of channels in spectrum
5. *energy span*	number	total energy span of detector calibration

Keys: Primary: *sample_id/sample_type*
Foreign: *sample_id* (**gards_sample_data**)

GARDS_XE_PROC_PARAMS_TEMPLATE

The **gards_xe_proc_params_template** table contains the detector and ROI dependent confidence factors used in nuclide identification.

Column	Storage Type	Description
1. *detector_id*	number	detector identifier
2. *roi*	number	ROI identifier
3. *constant*	number	confidence factor

Keys: Primary: *detector_id/roi*
Foreign: *detector_id* (**gards_detectors**)
roi (**gards_roi_lib**)

New Columns:

gards_relevant_nuclides
Column: *sample_type*
Storage Type: char(1)
Description: type of sample

gards_sample_aux
Column: *sample_diameter*
Storage Type: number
Description: diameter of gas chamber (cm)

II. Changes to support the new Radionuclide Lab Report (RLR) message:

New table:

GARDS_RLR

The **gards_rlr** table contains all data related to an RLR message.

Column	Storage Type	Description
1. *rlr_id*	number	identification code of related RLR
2. *station_id*	number	station identifier (relates to **gards_stations**.*station_id*)
3. *detector_id*	number	detector identifier (relates to **gards_detectors**.*detector_id*)
4. *ref_id*	number	sample reference identification
5. *collect_start*	date	sample collection start date
6. *collect_stop*	date	sample collection stop date
7. *arrival_date*	date	sample arrival date

8.	*test_date*	date	test completion date at lab
9.	*transmit_date*	date	transmit date
10.	*filename*	varchar2(256)	name of file containing the RLR

Keys: Primary: *rlr_id*

New sequence: **gards_rlr_seq**

III. Other Changes:

Table dropped: **gards_sample_history**

Columns dropped from **gards_nucl_lib**:
date_entered, *parent*, *daughter*, *key_line*

Columns dropped from **gards_nucl_lines_lib**:
accident_sum, *coincident*, *background*, *backscatter*,
compton, *single_esc*, *double_esc*

Columns dropped from **gards_xe_nucl_lib**:
date_entered, *parent*, *daughter*, *key_line*

Columns dropped from **gards_xe_nucl_lines_lib**:
accident_sum, *coincident*, *background*, *backscatter*,
compton, *single_esc*, *double_esc*

Columns dropped from **gards_detectors**:
station_id, *disp_lat_lon*, *bytes_chan*, *geometry*, *cooling_method*,
shield_type, *last_cal*, *cal_sample_id*, *cal_ctf*, *primary*

Columns dropped from **gards_stations**:
disp_lat_lon, *sponser*, *flowrate_m3*

Column dropped from **gards_met_data**:
ave_in_temp

Column modified in **gards_sample_description**:
description storage type changed to varchar2(512)
length field dropped

Column added to **gards_users**:
default_role, storage type: number

Columns dropped from **gards_nucl_ided**:
parent, *daughter*, *halflife_err*, *key_line*, *activ_sum*,
activ_sum_err, *num_lines*, *date_ided*, *reviewed*

Columns dropped from **gards_nucl_ided_orig**:
parent, *daughter*, *halflife_err*, *key_line*, *activ_sum*,
activ_sum_err, *num_lines*, *date_ided*, *reviewed*

Columns dropped from **gards_nucl_lines_ided**:
accident_sum, *coincident*, *background*, *backscatter*,
compton, *single_esc*, *double_esc*, *wtmean_reject*, *interfer_reject*

Columns dropped from **gards_sample_aux**:
blank_ref_id, *number_of_channels*, *energy_span*,
energy_per_channel, *first_split_id*, *second_split_id*, *sample_mass*,

sample_density

Sequence dropped: **gards_gsh_seq**

Appendix C – SERs Addressed by Radionuclide Monitoring System Software Upgrades

#	Synopsis	Comments
SER -048	Add naturals to Xe library	Naturals are now a part of the Xe library.

Glossary of Acronyms

2-D	two-dimensional
3-D	three-dimensional
API	application interface
ARR	Automated Radionuclide Report
ARSA	Automated Radioxenon Sampler/Analyzer
AutoDRM	Automatic Data Resource Manager
AWT	abstract window tool
CORIANT	Coincident Radiation Interactive Analysis Tool
CTBTO	Comprehensive Nuclear Test-Ban Treaty Organization
DETBKPHD	detector background pulse height data
DEV	development
GASBKPHD	gas background pulse height data
IDC	International Data Centre
JAI	Java Advanced Imaging
JDK	Java Development Kit
LAN	local area network
L_c	critical level
MDA	minimum detectable activity
MDC	minimum detectable concentration
NIMBIN	nuclear instrumentation module bin
PHD	pulse height data
PIDC	Prototype International Data Centre
R2	Release 2
R3	Release 3
R4	Release 4
RLR	Radionuclide Laboratory Report
RMS	Radionuclide Monitoring System
ROI	region of interest
RRR	Reviewed Radionuclide Report
SAMPLEPHD	sample pulse height data
SOH	state of health
SPALAX	noble gas monitoring unit developed by the Département Analyse et Surveillance de l’Environment (DASE) at the Commissariat à l’Ènergie Atomique (CEA) in France
SSREB	Standard Screened Radionuclide Event Bulletin